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M2Or1B-01 [Invited]: Comparative studies of vortex pinning and dynamics in superconductors

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Superconducting vortex physics has been a topic of interest since the discovery of the oxide high temperature superconductors (HTS). Two driving forces are behind this interest, on the one hand the attractive new physics and on the other the pursuit of technological uses. The complex vortex phenomena in oxide HTS arise from the strong influence of thermal fluctuations, which is a consequence of the small superconducting coherence length (ξ) and the large crystalline anisotropy (γ). Paradoxically these fluctuations are the main obstacle for applications; moreover the problem is general and will also occur in any yet-to-be-discovered high T_c superconductor. Although the rich vortex behavior in the oxides contrasts with the simpler physics in conventional low T_c superconductors (LTS), there is no sharp boundary between them. However, modern vortex matter models have been developed to describe the oxide HTS, thus it is important to test them in different systems. Iron-based superconductors provide an opportunity to “bridge the gap” and check the validity of vortex models in a large new family of materials with broad ranges of T_c,ξ and γ. Valuable information can also be obtained from MgB_2, $NbSe_2$, borocarbides and other LTS.

The overall goal of our research is to obtain a universal description of vortex matter in the presence of material inhomogeneities, applicable to all superconductors. Our approach is to compare and contrast systems with vastly different properties under a broad spectrum of conditions, including extreme ones. We also manipulate the vortex properties by nano-engineering the pinning landscape through the controlled introduction of disorder at the scale of ξ, utilizing second-phase inclusions, irradiations and doping. In this talk I will present examples of comparative vortex matter studies, with emphasis in our recent discovery of a universal lower limit for flux creep in superconductors.

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Author: Dr CIVALE, Leonardo (Los Alamos National Laboratory)

Presenter: MAIOROV, Boris (Los Alamos National Laboratory)

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